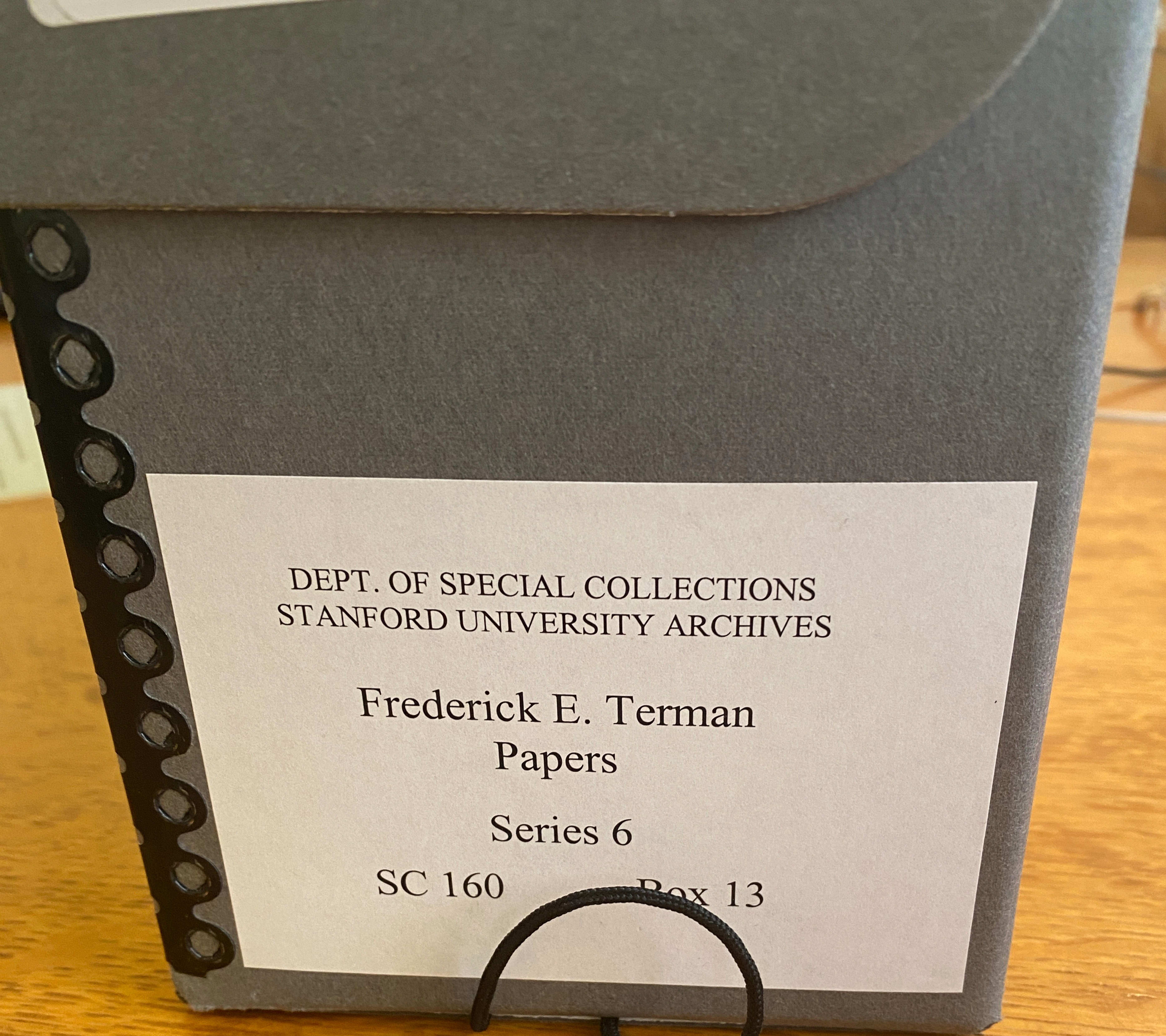

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SC 160 SERIES VI

N.R.A.C.
Report: Basic Research in the Navy, v. I

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVAL RESEARCH ADVISORY COMMITTEE
WASHINGTON 25, D. C.

IN REPLY REFER TO:

ONR:103:mdb
Ser N-389
14 Oct 1959

MEMORANDUM TO MEMBERS NAVAL RESEARCH ADVISORY COMMITTEE

Subj: Press release for A. D. Little report, "Basic Research in the Navy"

1. By enclosed letter of 12 October 1959 Dr. Suits transmitted the subject report and press release to approximately one hundred and fifty science news media.

OWHelm
O. W. HELM
Executive Secretary

NAVAL RESEARCH ADVISORY COMMITTEE
Washington 25, D. C.

ONR:103;mdb
Ser N-388
12 Oct 1959

The attached report, "Basic Research in the Navy", is the result of a study of this subject which has been sponsored by the Naval Research Advisory Committee. The work was done by A. D. Little, Inc., under a contract with the Office of Naval Research. The Committee feels that the work breaks new ground in applying new methods for measuring the amount of basic research that is done, illustrating the mission orientation of basic research in the Navy, and depicting the anatomy of basic research. The study we feel deserves to be called to the attention of many segments of the public in order that they might benefit from this "research upon research" which was done with public funds.

The report will be of considerable interest not only to the scientific community, but also to the general public, which is increasingly aware of the profound influence which modern science exerts on the lives of everyone. The illustrations have been carefully devised to lead readers to an understanding of the rich and fertile frontiers of knowledge upon which modern defense today depends so singularly.

Any use you may wish to make of the material in order to convey its message for the public benefit is encouraged, for release date of 4 P.M. October 22, 1959.

Sincerely yours,

C. G. Suits

C. G. SUITS
Chairman

Encl:
(1) Vol. I & II of rpt
(2) Press release

BASIC RESEARCH IN THE NAVY

(Press release for 4 P.M. October 22, 1959)

A study released by the Secretary of the Navy points to a fresh solution of the problem of how much basic research must be done in support of technological requirements of the Navy. The study has uncovered new facts of American effort in basic research - for example, only one-fifth of the nation's Ph.D. research scientists are engaged in basic research. This information results from a two-year study carried out for the Naval Research Advisory Committee (NRAC) by Arthur D. Little, Inc., of Cambridge, Massachusetts. Headed by Dr. Guy Suits, vice president and director of research of the General Electric Company, NRAC is the Navy's highest public advisory group on research.

Based on the investigation of basic research effort by U.S. industry, government, and universities, the report outlines the characteristics of such research and the pattern of basic research that has contributed significantly to present day weapons systems.

Under the direction of Dr. Burce S. Old, ADL vice president, the study concluded that "in this period of dynamic international technological competition, national survival is largely dependent upon speed of acquisition and application of new knowledge." Basic research, "the life-blood of the entire system of technological innovation," is deemed essential to the success of such a program. The report rests upon the accepted definition of basic research as responsible not only for developing new knowledge but also for communicating this to the rest of the scientific world. The authors of the report broke new ground in applying new methods for measuring the amount of basic research that is done, and explored the development of a mathematical model of the relationship between the different elements of the total research process.

A full field of technology evolves through basic research following a scientific discovery, the study shown in an interesting chart presentation. The formulation of shock wave theory by two English physicists, Challis and Stokes, in 1848 was one such innovation. The noise of jet planes crashing through the sound barrier has made this phenomenon familiar to most people today. The vast proliferations of applications of shock wave theory are found in acoustics, explosives, jet engines, wind tunnels, satellites, underwater sound, ballistic missiles and even thermonuclear devices. A Century of steady growth of the theory culminated with the 1940's in the rapid appearance of new contributions in these many fields which are central to our technology of this nuclear and space age.

According to the Navy report, much of the technology of modern weapons can be directly traced back to basic research. The scientific discoveries which led to the development of radar in the United States were made at NRL in 1922 and 1930 by A. Hoyt Taylor and D. A. Hyland. The original development of radar was sparked in 1934 by a brilliant idea of L. C. Young which pointed out the use to practical application of the discoveries in 1922 and 1930 to military use in the detection of ships and aircraft. Parallel but independent developments were taking place in other countries during the same period.

The report states that only those engaged in basic research can keep in touch with new developments on the forefront of science. Thus, it is through Navy sponsored scientists that new concepts come and are related to applied research and development objectives of the Navy. Without the contributions and influence of outstanding competent scientists, a research program cannot produce the necessary innovations. "Put another way, applied research and development tend to proceed more rapidly, and at lower cost, when adequately backed by basic research."

Dealing particularly with the problem of the people who perform basic research, the report observes that "they are exceedingly rare in number." Most of them have doctorate degrees, and it is a fact that only two percent of the nations' college graduates continue their education through the doctorate level. Of this two percent, only about one in five remain in basic research work. Only about one-half of these have the outstanding talents for creative work in basic research and they produce 80% of the scientific output. Thus, in the United States today there are only about 27,000 basic research scientists, of whom about half are producing the principal research results.

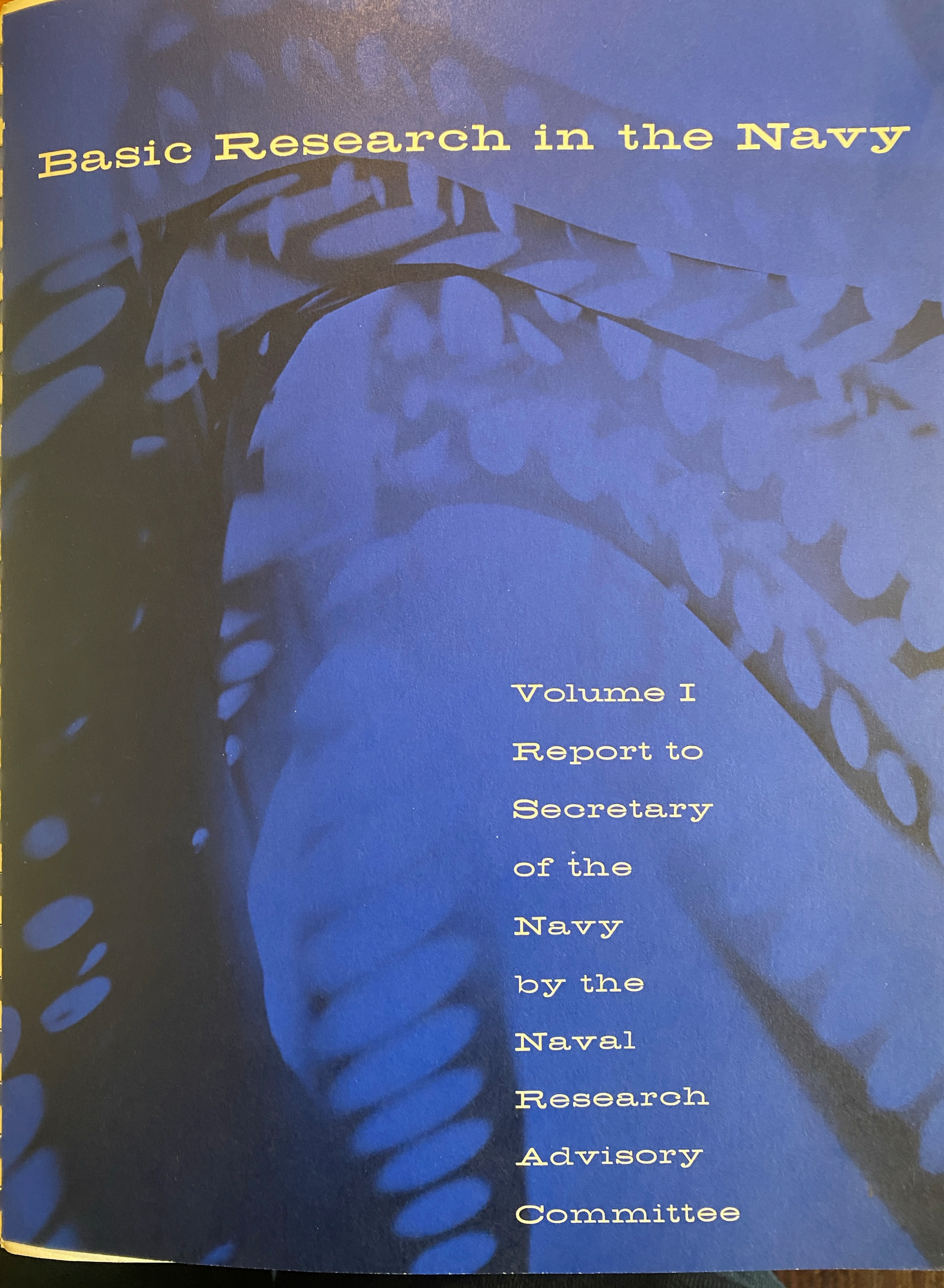
Participation by the Navy in basic research clearly is in furtherance of its mission, the two-volume study found. With a history of technological achievement dating back to 1777, the Navy is today pressed to keep up with the demands of the space age. However, between 1947 and 1957, many leading corporations were more aggressive in basic research than was the Navy.

The top corporations in the United States are investing a larger proportion of their research and development budgets in basic research, some as high as 20%. The majority of leading research directors interviewed thought that the complex nature of the Navy's mission required an allocation of some fifteen to twenty percent of the research and development budget to basic research. At present the Navy's ratio is six to eight percent.

The report recommends that the Office of Naval Research be charged with the responsibility of detailing basic research programs in specific fields of science. This would be the preliminary step to a basic research program supported by a budget double that of fiscal 1959.

The Office of Technical Services, Department of Commerce, has been given the responsibility for public distribution of the report.

Basic Research in the Navy



Volume I

Report to
Secretary
of the
Navy
by the
Naval
Research
Advisory
Committee

Volume I

A Report to the

Secretary of the Navy

on

Basic Research in the Navy

by the

Naval Research Advisory Committee

June 1, 1959

Table of Contents

Page

Letter from Chairman, NRAC, to the Secretary of the Navy v

Letter from the Secretary of the Navy to NRAC vii

Conclusions and Recommendations of NRAC ix

Acknowledgments by the Naval Research Advisory Committee xi

A Report to the Naval Research Advisory Committee on Basic Research in the Navy, prepared by Arthur D. Little, Inc. xiii

Members of The Naval Research Advisory Committee

Dr. R. F. Bacher, Chairman, Physics Dept., California Institute of Technology

Dr. C. C. Furnas, Chancellor, University of Buffalo

Dr. T. K. Glennan, Administrator, National Aeronautics and Space Administration

Mr. E. H. Heinemann, Vice President, Douglas Aircraft Company, Inc.

Dr. R. A. Kern, Temple University Hospital

Dr. A. B. Kinzel, Vice President, Union Carbide Corp.

Dr. J. W. McRae, Vice President, American Telephone and Telegraph Company

Mr. G. Norton, President, Institute for Defense Analysis

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Dr. R. Revelle, Director, Scripps Institution of Oceanography

Dr. F. Seitz, Chairman, Physics Dept., University of Illinois

Dr. C. G. Suits (Chairman, NRAC) Vice President and Director of Research, General Electric Company

Dr. F. E. Terman, Provost, Stanford University

Dr. E. A. Walker, President, Pennsylvania State University

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVAL RESEARCH ADVISORY COMMITTEE
WASHINGTON 25, D. C.

IN REPLY REFER TO:

ONR:103:jg
Ser N-152
24 Apr 1959

My dear Mr. Gates:

The report transmitted herewith for your consideration marks a beginning of research on research in the Navy. We are fully aware that without development, production and operational training, there can be no effective fighting force. However, the current thinking with respect to research, and especially basic research as a Naval requirement, is much less clear and the relationships in this area have not been fully developed. This report begins to lay the basis for a clear expression of the requirement, bearing in mind that the success of the Navy in accomplishing its mission in competition with other world powers depends largely on a continuous flow of new and better weapons and techniques. This in turn, requires the continuous development of new technologies which have their roots in the results of basic research.

The report strongly supports the Navy's need for basic research. Only by active participation in a program for which it assumes a direct responsibility can the Navy insure a rapid flow of the products of new science from the laboratories of the Nation into the uses of the Service.

The Naval Research Advisory Committee believes that this report makes an appreciable contribution to a development of the understanding of the relationship of basic research to the missions of the Navy. However, we are acutely aware of many unsolved problems and we hope this report will provide the basis for further study.

The Committee urges that the Navy implement the recommendations of the Naval Research Advisory Committee, herewith presented.

Very truly yours,

C. G. Suits

C. G. SUITS, Chairman
Naval Research Advisory Committee

Honorable Thomas S. Gates, Jr.
Secretary of the Navy
Washington 25, D. C.

Acknowledgments

It is a distinct pleasure to be able to state that assistance in the preparation of this report has been willingly supplied by a great many individuals associated with Government, universities, and industry who were consulted during the course of the study. To list all to whom we are indebted would literally require several pages.

In particular we would like to acknowledge the assistance of the Office of Naval Research, U. S. Naval Training Device Center, R. C. Cowen, and the following individuals associated with this study through the Naval Research Advisory Committee: L. A. Cookman, W. H. Doherty, M. J. Kelly, A. B. Kinzel, R. W. Larson, L. McKenzie, G. M. Murrow, E. R. Piore, and C. G. Suits, Chairman.

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Bruce S. Old, Project Director

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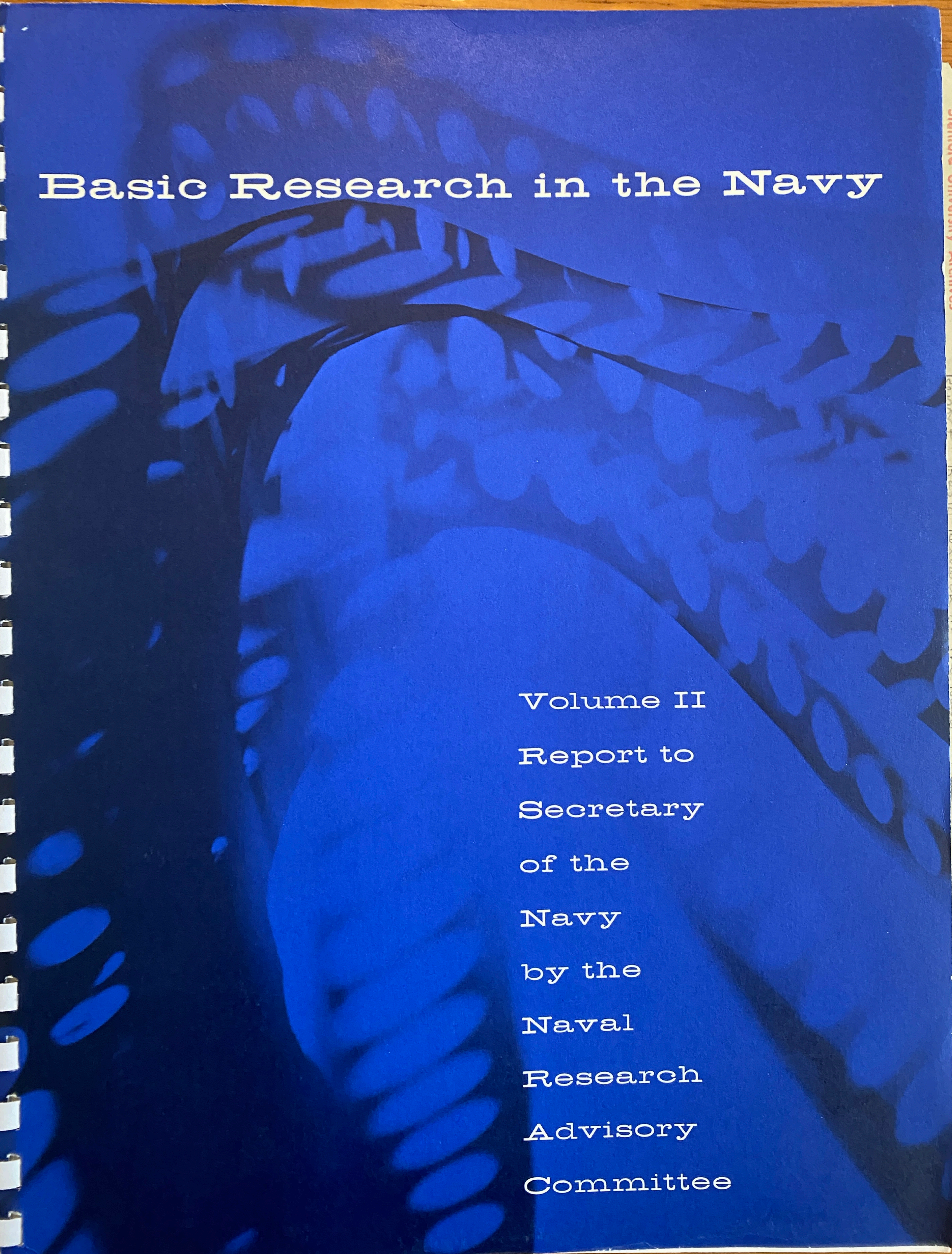
N.R.A.C.
Report; Basic Research in the Navy, v. II

Basic Research in the Navy



Volume II

Report to
Secretary
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N.R.A.C.
Report: Basic Research in the Navy v. II

Volume II

A REPORT TO THE

Secretary of the Navy

ON

Basic Research in the Navy

BY THE

Naval Research Advisory Committee

June 1, 1959

Report Prepared
by

Arthur D. Little, Inc.

UNDER OFFICE OF NAVAL RESEARCH CONTRACT NO. NONR-2516(00)

Introduction

Upon the recommendation of the Naval Research Advisory Committee, the Office of Naval Research initiated a contract with Arthur D. Little, Inc., February 1, 1958, to perform a study to determine a basis for decision as to the proper level of support of basic research by the Navy Department.

The report of this study is in two parts. Volume I is a brief monograph setting forth the principal findings. This is under separate cover. Volume II is a series of memoranda covering studies undertaken during the assignment, which led up to the principal findings. These are submitted herewith in the following appendixes:

- A. Method of Approach
- B. Mathematical Model
- C. Manpower Studies
- D. Chronology of Naval Technical Developments
- E. References and Source Material

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Report: Basic Research in the Navy, v. II

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